

AMENDMENTS TO THE SPECIFICATION

Please amend the paragraph on page 5, line 19, with the following amended paragraph:

[0018] The present invention relates to a composite material using titanium or a titanium alloy, and its objective is to provide a composite material having simple and good workability, in which titanium or a titanium alloy and an ~~adhere~~ adherend are allowed to exert a stable, superior adhesive property at room temperature as well as even after exposure to a high temperature under high-humidity. For this purpose, the present invention provides titanium or a titanium alloy that exerts a superior adhesive property in a stable manner. Moreover, the present invention provides an adhesive resin composition, an adhesive resin film and a prepreg, which exert a stable, superior adhesive property to titanium or a titanium alloy. The present invention also provides a composite material in which these titanium or titanium alloy, adhesive resin composition, adhesive resin film and prepreg are used. Moreover, the present invention also provides a surface treatment method of metal and a manufacturing method of such a composite material.

Please amend the paragraph on page 6, line 22, with the following amended paragraph:

[0025] A composite material of the present invention has a structure in which titanium or a titanium alloy, surface-treated by an imidazole compound, is adhered to an ~~adhere~~ adherend.

Please amend the paragraph on page 6, line 25, with the following amended paragraph:

[0026] Moreover, a composite material of the present invention is formed by allowing titanium or a titanium alloy and an ~~adhere~~ adherend to adhere to each other through an adhesive resin layer formed by curing the adhesive resin composition or the adhesive resin film.

Please amend the paragraph on page 9, line 9, with the following amended paragraph:

- [0038] 1. Titanium or titanium alloy
2. Adhesive surface
3. Adhesive resin layer
4. Thermoplastic resin in a cohesive phase and in a discontinuously distributed state
5. Thermosetting resin
6. ~~Adhere~~ Adherend
7. Thermoplastic resin in a non-cohesive phase
8. Carbon fiber reinforced plastic

Please amend the paragraph on page 20, line 29, with the following amended paragraph:

The titanium or titanium alloy of the present invention, thus surface-treated by an imidazole compound, is allowed to exert a superior adhesive property stably on an ~~adhere~~ adherend. Here, the expression “surface-treated by an imidazole compound” refers to the fact that the imidazole compound is adhered to the adhesion-related surface (hereinafter, referred to as “adhesion surface”) of titanium or a titanium alloy. The following description will discuss a method of the surface treatment.

Please amend the paragraph on page 21, line 4, with the following amended paragraph:

[0065] First, the adhesion surface of titanium or a titanium alloy is subjected to a sanding or blasting process by using a sand paper, a sand-blasting process or a wet-blasting process. The wet-blasting process refers to a process in which the blasting is carried out by using a solution in which a polishing agent is mixed with water, and in this method, since the blasting process can be carried out with oxygen being blocked, it becomes possible to provide a preferable method. After having been subjected to a sanding process or a blasting process, the adhesion surface is washed and defatted with an organic solvent such as acetone or ethanol. Next, the adhesion surface of titanium or a titanium alloy is processed by using an imidazole compound or an imidazole compound solution in which the imidazole compound is dissolved in water or ethanol. The surface treatment is preferably carried out so that the adhesive property can be improved and in the case when the ~~adhere~~ adherend contains an epoxy resin composition, the imidazole compound serves as a curing agent or a curing accelerator to accelerate the curing process of the epoxy resin on the adhesion surface and also to desirably improve the curing degree. In

particular, in the case when the titanium or the titanium alloy is surface-treated by using the imidazole compound solution, in particular, in a state in which after the wet blasting process, the blasted surface has not been dried, since the surface treatment is carried out with oxygen being blocked, it is possible to provide a preferable process.

Please amend the paragraph beginning on page 21, line 32, and bridging to page 22, line 11, with the following amended paragraph:

[0067] The combination rate of less than 0.1% by weight makes the amount of the imidazole compound too small to fail to provide a sufficient adhesive effect. The combination rate exceeding 10% by weight fails to further improve the adhesive strength, and also causes conspicuous deposition of the imidazole compound on the treatment surface after the solvent has been evaporated from the treatment surface of titanium or a titanium alloy, resulting in degradation in the handling property. In the case when the amount of the imidazole compound is too much, if the resin of the ~~adhere~~ adherend contains an epoxy resin composition, the imidazole compound functions as a curing agent or a curing catalyst to accelerate the curing reaction beyond the necessary level, failing to provide an appropriate process.

Please amend the paragraph on page 27, line 1, with the following amended paragraph:

[0086] The mode of the thermoplastic resin is not particularly limited, and non-woven fabrics or films may be used on demand. Among these, spherical particles are preferably used because the use of these improves the filling rate of the thermoplastic resin. In particular, fine particles having a diameter of 1 to 50 μm are more preferably used. Most preferably, those

particles having a diameter of 3 to 20 μm are used. In particular, in the case when fiber reinforced plastic is used as the ~~adhere~~ adherend, by setting the diameter of the fine particles to 3 to 20 μm , it becomes possible to preferably improve the filling rate without disturbing the arrangement of the fibers.

Please amend the paragraph beginning on page 28, line 19, and bridging to page 29, line 12, with the following amended paragraph:

[0090] In particular, in the case when no imidazole compound is used, a crystalline thermoplastic resin is preferably used as the thermoplastic resin. More preferably, a crystalline thermoplastic resin having a melting point of 200°C or less is used. In the case when no imidazole compound is used, the adhesive property is preferably improved by allowing the thermoplastic resin to form a discontinuous phase as well as a cohesive phase in the adhesive resin composition that has been cured, as described above. Upon molding, by heating the thermoplastic resin to a temperature that is the melting point or more, the thermoplastic resin is fused or becomes a state close to the fused state in the adhesive resin composition, and since adjacent thermoplastic resin particles are fused to each other, the resulting resin is formed into a cohesive phase. In particular, in the when the ~~adhere~~ adherend is prepared as fiber reinforced plastic, since the upper limit of the molding temperature becomes about 200°C in most cases, the melting point of the thermoplastic resin is preferably set to 200°C or less, in order to allow the thermoplastic resin to have a cohesive phase at the molding temperature. Moreover, by carrying out a molding process at the melting point or more of the thermoplastic resin, the thermoplastic resin is fused or becomes close to the fused state so that the adhesive property to the

thermosetting resin is preferably improved. In particular, polyamide is a thermoplastic resin superior in its adhesive property; therefore, from the above-mentioned point of view, crystalline polyamide having a melting point of 200°C or less is preferably used.

Please amend the paragraph on page 29, line 17, with the following amended paragraph:

[0092] With respect to a ~~thermoplastic~~ thermosetting resin to be used for the adhesive resin composition, an epoxy resin is preferably used. The epoxy resin is superior in the adhesive property and mechanical characteristics. Moreover, within the range of the combination rate of the imidazole compound of the present invention, since the imidazole compound improves the adhesive property, and also accelerates the curing reaction of the epoxy resin, it is possible to form a firm adhesive resin layer.

Please amend the paragraph on page 29, line 24, with the following amended paragraph:

[0093] Moreover, in the case when a plastic-based material is used for the ~~adhere~~ adherend, the same material as or a material similar to the material used for the plastic of the ~~adhere~~ adherend is preferably used. By using the same material or similar materials as plastic materials for both of the adhesive resin composition and the ~~adhere~~ adherend, the adhesive property thereof can be preferably improved.

Please amend the paragraph beginning on page 29, line 30, and bridging to page 30, line 6, with the following amended paragraph:

[0094] With respect to the base resin for the adhesive resin composition, the above-mentioned thermoplastic resin may be used in place of the thermosetting resin. By using the thermoplastic resin as the base resin, the toughness of the adhesive resin composition is preferably

improved. In particular, in the case when the ~~adhere~~ adherend is formed by a plastic material made from a thermoplastic resin, an adhesive resin composition using the same kind of the thermoplastic resin as the base resin is preferably used from the viewpoints of the adhesive property and moldability.

Please amend the paragraph beginning on page 34, line 15, with the following amended paragraph:

By using the above-mentioned method, it becomes possible to form a composite material in which titanium or a titanium alloy and an ~~adhere~~ adherend are allowed to have a superior adhesive property in a stable manner. Among the above-mentioned methods, preferably, two or more of those may be used in combination.

Please amend the paragraph beginning on page 34, line 20, with the following amended paragraph:

[0103] With respect to the ~~adhere~~ adherend, not particularly limited, plastic-based materials, metal materials and the like may be used. With respect to the plastic-based materials, both of the thermosetting resin and thermoplastic resin may be used. In the case when the thermosetting resin is used, either of methods in which, after such a resin before the curing process has been bonded to titanium or a titanium alloy, the thermosetting resin is cured and in which a thermosetting resin that has been preliminarily cured is bonded to titanium or a titanium alloy, may be used.

Please amend the paragraph beginning on page 36, line 4, with the following amended paragraph:

[0107] With respect to the ~~adhere for~~ adherend of a metal material, another titanium or titanium alloy may be used. Although the titanium or titanium alloy is superior in mechanical properties, it is poor in workability, and hardly molded into a complicated shape. Therefore, by using the present invention, titanium members or titanium alloys can be mutually adhered to each other so that titanium or a titanium alloy is desirably formed into a complicated shape. Of course, another metal or alloy, such as an aluminum alloy, may be preferably used as the ~~adhere~~ adherend.

Please amend the paragraph beginning on page 36, line 18, with the following amended paragraph:

[0110] In the case when the ~~adhere~~ adherend is prepared as a resin that has been cured, metal or the like, first, an adhesive resin is applied onto the adhesion surface of the titanium or titanium alloy that has been surface-treated through the above-mentioned method, by using a method such as a coating method, a dipping method and a spraying up method, or a plate-shaped or film-state adhesive resin is placed on the adhesion surface of the titanium or titanium alloy. Next, the ~~adhere~~ adherend is laminated on the adhesive resin, and by curing the adhesive resin under curing conditions having predetermined temperature, pressure and the like, the ~~adhere~~ adherend is adhered to the titanium or titanium alloy. Of course, after the adhesive resin has been preliminarily applied to the adhesion surface of the ~~adhere~~ adherend, this may be laminated so that the adhesive resin is placed on the adhesion surface of the titanium or titanium alloy to be adhered thereto.

Please amend the paragraph beginning on page 36, line 33, and bridging to page 37, line 4, with the following amended paragraph:

[0111] Here, with respect to the adhesive resin, any conventional bonding agent suitable for the ~~adhere~~ adherend, such as a plastic material or a metal material, may be used. Moreover, the adhesive resin composition of the present invention may also be used preferably.

Please amend the paragraph beginning on page 37, line 5, with the following amended paragraph:

[0112] In the case when the ~~adhere~~ adherend is prepared as a plastic material prior to its curing process, after the plastic material prior to the curing process has been applied onto the adhesion surface of the titanium or titanium alloy that has been surface-treated through the above-mentioned method, by using a method such as a coating method, a spraying up method, and a dipping method or after a plate-shaped or film-state plastic material prior to the curing process has been placed on the adhesion surface of the titanium or titanium alloy, the plastic material is cured under curing conditions having predetermined temperature, pressure and the like of the plastic material so that the adhering process can be carried out. In the case when the ~~adhere~~ adherend is prepared as a coating material, such as a urethane coating material and an acryl coating material, as well, the same process can be carried out.

Please amend the paragraph beginning on page 39, line 15, with the following amended paragraph:

[0121] Next, after an adhesive resin composition has been applied to the adhesion surface of the titanium or titanium alloy by using a coating method, spraying up method, a dipping method or the like, an ~~adhere~~ adherend is laminated on the adhesive resin composition so that, by curing the adhesive resin composition in accordance with curing conditions having predetermined temperature, pressure and the like, the ~~adhere~~ adherend can be adhered thereto. Of course, after an adhesive resin composition has been preliminarily applied to the adhesion surface of the ~~adhere~~ adherend, this may be laminated so that the adhesive resin composition is placed on the adhesion surface of the titanium or titanium alloy to be adhered thereto.

Please amend the paragraph beginning on page 40, line 5, with the following amended paragraph:

[0123] In the case when the ~~adhere~~ adherend is prepared as a plastic material prior to its curing process, after the plastic material prior to the curing process has been laminated on the adhesive resin composition, the adhesive resin composition can be cured in accordance with curing conditions having predetermined temperature, pressure and the like of the adhesive resin composition, with the plastic material being simultaneously cured. In the case when the curing reaction of the plastic material of the ~~adhere~~ adherend is insufficient under the curing conditions of the adhesive resin composition, after a plastic material has been adhered by curing the adhesive resin composition, the plastic material may be again sufficiently cured in accordance with curing conditions of the plastic material so that the plastic material is sufficiently cured, with the ~~adhere~~ adherend

being adhered and molded thereon.

Please amend the paragraph beginning on page 41, line 7, with the following amended paragraph:

[0128] Next, after an adhesive resin film has been laminated to the adhesion surface of the titanium or titanium alloy, an ~~adhere~~ adherend is laminated on the adhesive resin film, and the adhesive resin composition forming the adhesive resin film is cured under curing conditions having predetermined temperature, pressure and the like so that the ~~adhere~~ adherend can be adhered thereto.

Please amend the paragraph beginning on page 41, line 13, with the following amended paragraph:

[0129] Of course, after an adhesive resin film has been preliminarily applied to the adhesion surface of the ~~adhere~~ adherend, this may be laminated so that the adhesive resin film is placed on the adhesion surface of the titanium or titanium alloy to be adhered and molded thereon.

Please amend the paragraph beginning on page 42, line 12, with the following amended paragraph:

[0135] The composite material of the present invention obtained through the above-mentioned method is allowed to have a peel torque of 5N-mm/mm or more required for peeling the ~~adhere~~ adherend from the titanium or titanium alloy upon measurements of the adhesive property (hereinafter, referred to as CDP test) between the titanium or titanium alloy and the ~~adhere~~ adherend that

has been adhered thereon, in compliance with ASTM D 1781-98 (1998) . More preferably, the peel torque is set to 10N-mm/mm or more.

Please amend the paragraph beginning on page 42, line 24, and bridging to page 43, line 10, with the following amended paragraph:

[0137] In general, upon evaluating an adhesive property, a testing process for a lap shear adhesive strength, as described in JIS K 6850 (1999) "Lap shear adhesive strength testing method between adhesive and rigid ~~adhere~~ adherend", is carried out. However, the lap shear adhesive strength does not necessarily correspond to a peeling strength that is actually exerted. This lap shear adhesive strength testing method is effectively used for a case in which an ~~adhere~~ adherend having a comparatively good adhesive property is used, with the fracture behavior at the adhered portion being set in a shear mode. However, this method is not effectively applied to a case in which an ~~adhere~~ adherend, such as titanium or a titanium alloy, that is extremely poor in adhesive property is used, with the fracture behavior at the adhered portion being set in a peel mode. In the case when titanium or a titanium alloy is used as the ~~adhere~~ adherend, even when a lap shear adhesive strength is being exerted to a certain degree, a peeling frequently occurs easily in the peel mode. For this reason, with respect to a method used for more effectively evaluating the adhesive property, a method for measuring a peel torque, described in ASTM D 1781-98, is preferably used.